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AUSTRALIA

**Patents Act 1990**

COMPLETE SPECIFICATION

FOR A STANDARD PATENT

(ORIGINAL)

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Invention Title: **"An ignition lock system"**

Details of Associated Provisional Application No: PO9181/97
PO9480/97
PP1089/97

The following statement is a full description of this invention, including the best method of performing it known to us:

# A LOCK SYSTEM FOR A VEHICLE

The present invention relates to a lock system for a vehicle.

Most ignition lock systems for vehicles currently require an ignition key with a mechanically coded shaft to be inserted into a lock barrel and rotated to activate an ignition switch of the system. Only a mechanically coded key that corresponds to the lock barrel can be used to activate the ignition switch and start the vehicle. The mechanical lock assemblies used in the ignition locks are relatively expensive to implement and provide less security than that which is available with electronic systems used for vehicle entry. Accordingly, it would be advantageous to provide an ignition lock system which alleviates or minimises these disadvantages or at least provides vehicle manufacturers with a useful choice.

In accordance with the present invention there is provided a lock system for a vehicle, including:

authentication means for receiving authentication code transmitted from a remote electronic key and for generating an authentication signal; and

an ignition lock assembly having:

an ignition switch unit;

a part movable between at least first and second positions to activate said ignition switch unit;

electronic lock means responsive to said authentication signal for generating a lock release signal; and

a lock mechanism which inhibits use of said vehicle and in response to said lock release signal enables use of said vehicle.

An electronic system for an ignition and steering lock assembly, including:

authentication means for receiving authentication code transmitted from a remote electronic key and for generating an authentication signal;

electronic lock means of said assembly, responsive to said autentication signal for

generating a lock release signal to release a lock mechanism of said assembly; and

an ignition switch unit of said assembly which generates signals representative of the position of movable part of said assembly for said electronic lock means, said part being movable between at least first and second positions to activate said ignition switch unit.

The present invention further provides a lock system for a vehicle, including:

a steering lock tongue which is biased to actuate a steering lock mechanism;

a lock mechanism for preventing movement of said lock tongue to actuate said steering lock mechanism; and

electronic lock means for controlling said lock mechanism to enable said lock tongue to engage said steering lock mechanism when predetermined data is received.

Preferred embodiments of the present invention are hereinafter described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is an isometric, partial cross-sectional, view of a preferred embodiment of an ignition lock assembly of an ignition lock system;

Figure 2 is a partial cross-sectional view of the ignition lock assembly;

Figure 3 is a block diagram of the ignition lock system;

Figure 4 is an isometric, partial cross-sectional, view of another preferred embodiment of a lock assembly;

Figure 5 is a block diagram of the lock assembly of Figure 4;

Figure 6 is a block diagram of part of the assembly of Figure 4;

Figure 7 is a block diagram of an alternative lock tongue of the assembly of Figure 4; and

Figures 8 to 10 are schematic diagrams showing the different positions of the alternative lock tongue for different states of the lock assembly of Figure 4.

An ignition and steering lock assembly 4 of an ignition lock system, as shown in Figures 1 and 2, includes a standard ignition switch 6, a standard steering lock mechanism, having a lock tongue 8, and a rotary knob 10 which can be rotated between an OFF position 12, an ACC position 14 and IGN position 16 and a fourth optional and momentary START

or CRANK position 17. The mechanical lock mechanism, which includes a lock barrel is however removed. The mechanical lock mechanism normally prevents movement of the rotary knob 10, unless a corresponding mechanically coded key is inserted into the assembly 4. The assembly 4, instead, includes a solenoid 18 with a movable locking plunger 20, which when extended prevents movement of the rotary knob 10 between the OFF and the ACC positions 12 and 14, unless vehicle access authority is proven. The solenoid 18 is sealed within the housing of the assembly 4. The plunger 20 of the solenoid 18 is spring loaded, which leaves the plunger in an extracted position when the solenoid is not energised.

When the solenoid 18 is activated or energised, on access authentication, the locking plunger 20 is retracted to allow the rotary knob 10 to be moved between the OFF and ACC positions 12 and 14. The rotary knob 10 is coupled by a shaft mechanism 22, as shown in Figure 2, to the ignition switch 6, so that rotation of the knob 10 to the IGN position 16 or the optional START position 17 will activate the ignition switch 6, initiate driver authentication and start the vehicle if driving authority is proven.

The rotary knob 10, as shown in the Figures, includes a rear recessed portion 24 for receiving the locking plunger 20 in OFF position 12. Once the vehicle has been started, the rotary knob 10 is held in the START position, until a person positively switches off the vehicle by returning the knob 10 to the ACC or OFF positions 14 or 12. To proceed from ACC position 14 to OFF position 12 a push and turn movement is required. More particularly, the knob 10 is pushed in while in the ACC position 14 and then turned to the OFF position 12 to enable steering lock activation. The vehicle is then locked by an electronic key 40, which may be a remote key, smart card or transponder of a passive entry system, to deactivate the solenoid 18 via messages issued from a door lock module 30 to an ignition lock module 32, as described below. The key 40 can include two communication protocols, one for enabling vehicle entry and the solenoid 18 to be energised, and a more secure protocol for communicating with the electronic system to enable starting of the vehicle, i.e. driver authentication.

An electronic system, as shown in Figure 3, includes a door lock control module 30

having a code reader or transceiver, an ignition lock control module 32 for the solenoid 18, a driver authority reader or transceiver 39, which are connected by a bus system or Local Area Network (LAN) 34 within the vehicle. The bus system 34 also connects the code reader 30 to the vehicle's Engine Management System (EMS) module 36 and a siren or sounder module 41. The ignition switch 6 generates switch position outputs 38, representative of the position of the knob 10, which are coupled to the ignition lock control module 32. These switch position outputs 38 are processed by the ignition lock control module 32 and then made available to the bus system 34 as status messages. The door lock module 30 communicates with the key 40 to obtain an access authentication code which allows the rotary knob 10 to be turned. The module 30, on interrogating the electronic key for the access authentication code, exchanges code, which may be encrypted, with the EMS module 36 and the ignition lock control module 32. Actuation of a door handle switch 37 of the vehicle will cause access interrogation to occur. The ignition lock control module 32 includes processing circuitry to validate the access authentication code, which may involve executing a decryption procedure. On validating the access authentication code the module 32 generates a drive signal for the solenoid 18 to retract the plunger 20, as shown in Figure 3. This allows the knob 10 to be turned and ultimately the vehicle to be started by turning the knob 10 to the ACC position 14 and then the IGN position 16 or the optional START position, provided driving authority is obtained.

The electronic key 40 may be implemented as remote control key with activation buttons or as a key or smart card without buttons in a passive entry system. The key 40 can rely on a communication signal by activation of the switch 37 for activation of the communications protocol.

Access authority and driving authority are granted in two separate steps for reasons of theft security as well as operational safety. Access authority affects the solenoid 18, while driving authority affects the success of an attempt to crank the engine of the vehicle. Once the engine is running no authority checks are required. During the authority checks the key 40 needs to be within proximity of the reader modules 30 and 39. The preferred sequence of steps for unlocking, driving and locking the vehicle is as follows:

1. Activate an access authentication procedure by a button of the key 40 or activating the door handle switch 37. The door module 30 sends an encrypted authentication message. The ignition lock module 32 receives the access authentication message and activates the solenoid 18 to retract its plunger 20 for release of the rotary knob 10.

2. The rotary knob 10 is pushed in and turned from the OFF position to ACC position 14.

3. The rotary knob is turned from the ACC position 14 to the IGN position 16 or the optional START position 17. The ignition signal feed provides an activation signal to the module 39 to activate the driving authentication procedure. If driving authority is proven the module 39 places a driving authentication message on the bus system 34 where it activates the EMS module 36 causing it to start (crank) the engine.

4. When the rotary knob 10 is turned from the IGN position 16 to the ACC position 14, the engine stops.

5. The knob 10 is pushed in while in the ACC position 14 and turned to the OFF position 12 to engage the steering lock mechanism 8.

6. The vehicle is locked using a button on the key 40 or door handle switch 37. This deactivates the solenoid 18 via a bus message issued by the door lock module 30 and sent to the ignition lock module 32. The spring mounted in the solenoid pushes the plunger 20 into the rear recessed receptacle 24 of the rotary knob 10. This ensures the knob 10 is locked if the vehicle is not driven after vehicle access.

If step 5 is missed by moving directly from step 4 to step 6 a warning signal is emitted and/or the door lock system will not activate. This prompts a user of the vehicle to return and execute step 5. The ignition lock control module 32 uses the switch position outputs 38 to determine ignition lock status and a bus message can be output if it receives a lock message from the door lock module 30 that does not conform or comply with the current position of the switch 6. This bus message is directed to the door lock control module 30 and/or the sounder module 41 for action. The door lock module 30 may ignore a request for actuation.

An alternative lock system 104, as shown in Figures 4 to 10, removes any requirement to provide a warning signal for actuation of the steering lock mechanism as it is automatically activated when the engine is turned off, the vehicle at rest and the doors locked. Alternatively, the steering lock mechanism can be engaged when it is detected that the doors are locked and the electronic key 40 is out of range of the reader modules 30 and 39.

The ignition and steering lock assembly 104 again does not include any mechanical ignition lock mechanism, as the lock barrel is removed, and again there is no provision whatsoever for insertion of a coded shaft ignition key into the rotary knob 110. Also the solenoid 18 for the rotary knob 10 is replaced by an electromechanical blocking mechanism (EMB) 88 with a spring loaded plunger 86 which acts on the lock tongue 80, as described below. The EMB 88 may be a solenoid or a driven motor. Accordingly, there is no recessed portion 24 in the knob 110. For the ignition lock assembly 104, there is also no OFF position. The rotary knob 110 of the assembly 104 is able to move between an ACC position 12 and an IGN position 14, and can also be moved from the IGN position 14 to an optional and only momentary START or CRANK position 16.

Automatic actuation of the steering lock mechanism is provided by incorporating in the assembly 104 the steering lock tongue 80, which is the same as the lock tongue 8 in that it is spring loaded by a bias spring 82, except that it includes a side wall cavity 84, as shown in Figure 6. The side wall cavity 84 is for receiving the plunger 86 of the EMB 88 which is electrically connected to the lock module 32 for activation. When the driver is inside the car with the engine running, the steering lock mechanism will be disengaged and the lock tongue 80 will be in the position, position A, as shown in Figure 6. The EMB 88 under the action of a bias spring 90 will cause the plunger 86 to engage the tongue 80 within the cavity 84 so as to hold the tongue 80 in position A. The tongue 80 can therefore only be released to engage the steering lock mechanism, by energising the EMB 88 and retracting the plunger 86. The ignition lock module 32 will instruct this to occur when it detects that the rotary knob 10 has been moved from the IGN position 14 to the ACC position 12, and the module 32 also receives a signal or signals to indicate (1) the doors of the vehicle have been locked, and (2) the vehicle speed is zero. The lock tongue 80 will then be released to engage the steering lock

mechanism under the action of the tongue bias spring 82. The tongue 80 will move to position B indicated by the dotted lines 92, when the steering wheel is not centred, and will then move to position C indicated by the doted lines 94, when the steering wheel does become centred. This ensures the steering lock mechanism can be engaged after a driver turns off the engine, the vehicle is stationary, and the doors have been locked. The steering lock mechanism can subsequently be released, as discussed previously, by pushing in and moving the rotary knob 10.

Advantageously, the lock assembly 104 can be configured so that the steering lock mechanism is mechanically linked to the shaft 22 for movement of the rotary knob 10, such that when the lock tongue 80 is released to engage the steering lock mechanism, this also simultaneously invokes a lock mechanism to prevent movement of the rotary knob 10, as described below.

For secure electronic release of the rotary knob 10 and the steering lock mechanism, the tongue 80 can be configured to include an additional cavity 85, as shown in Figure 7, which is lower than the first cavity 84, so that the plunger 86 is received by the lock tongue 80, when it is engaged in position C with the lock mechanisms engaged. This will ensure that the lock mechanisms can only then be released after an electronic release procedure involves the EMB 88 being energised.

With the lock tongue 80 including two cavities 84 and 85, as shown in Figures 8 to 10, whilst the vehicle is being driven, the EMB 88 will have its plunger 86 engaging the first cavity 84 so the tongue 80 is in position A, as shown in Figure 8. With the lock tongue 80 in position A, the driver is free to move the rotary knob 110 from the IGN position 14 to the ACC position 12 to turn off the engine. When, as described previously, the doors of the vehicle have been locked and the vehicle speed is zero, the ignition lock module 32 will instruct the EMB 88 to retract the plunger 84 so as to release the tongue 80 so it can move under the action of the bias spring 82 to position B or C, depending on whether the steering wheel is centred. Where on subsequently entering the vehicle, the steering wheel is centred or is moved so as to become centred, the lock tongue 80 will be in position C, as shown in

Figure 10, and the steering wheel lock mechanism will be engaged. With the steering lock mechanism also linked to the lock mechanism for the rotary knob 110, it will not be possible to move the rotary knob 110 from the ACC position 12 to the IGN position 14 or the start position 16. In position C, the plunger 86 of the EMB 88 is extended by the action of its bias spring 90 so as to engage the second cavity 85, thereby locking the tongue 80 in position C. Accordingly, the steering wheel nor the rotary knob 110 of the vehicle can be moved unless the following release procedure is correctly executed. The release procedure involves:

(i) pushing in the rotary knob 110 to initiate execution of the driver authentication procedure.

(ii) the ignition lock 132 detects pushing in of the lock module 110 and instructs the driver authority reader 39 to interrogate the electronic key 40.

(iii) when driver authority is proven following execution of the driver authentication procedure, a positive message is passed to the ignition module 32.

(iv) the ignition lock module 32 instructs the EMB 88 to retract the plunger 86, and the steering mechanism and ignition lock mechanism can be released by pushing in and turning the rotary knob 110 and turning the steering wheel of the vehicle.

If desired, a second EMB can be included to act on the lock mechanism for the rotary knob 110.

Many modifications will be apparent to those skilled in the art without departing from the scope of the present invention as hereinbefore described.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A lock system for a vehicle, including:

authentication means (30,39) for receiving authentication code transmitted from a remote electronic key (4) and for generating an authentication signal; and

an ignition lock assembly (4,104) having:

an ignition switch unit (6);

a part (10,110) movable between at least first and second positions (12,14,16,17) to activate said ignition switch unit (6);

electronic lock means (32) responsive to said authentication signal for generating a lock release signal; and

a lock mechanism (18,80,88) which inhibits use of said vehicle and in response to said lock release signal enables use of said vehicle.

2. A lock system as claimed in claim 1, wherein said lock mechanism (18,80,88) has a locking part (20,86) which acts to prevent movement of the movable part (10,110) between said first and second positions (12,14,16,17), and said lock mechanism (18,80,88) allows movement of the movable part when said lock release signal is received.

3. A lock system as claimed in claim 2, wherein said locking part (86) acts to engage a steering lock tongue (80) of said ignition lock assembly (104), when said lock tongue (80) is in a locked position, to prevent movement of said lock tongue (80), and said lock mechanism retracts said locking part (86) to allow movement of said tongue (80) when said lock release signal is received.

4. A lock system as claimed in claim 2, wherein said locking part (20) engages said moveable part (10,110) in one of said positions to prevent movement of said movable part (10,110).

5. A lock system as claimed in any one of the preceding claims, wherein said movable part is a rotatable knob (10,110) coupled to said ignition switch unit 6.

6. A lock system as claimed in claim 1, wherein said lock mechanism (18,80,88) has a locking part (86) which acts to engage a steering lock tongue (80) of said ignition lock assembly (104), when said lock tongue (80) is in an unlock position, to prevent movement of said lock tongue (80), said electronic lock means (32) is responsive to a lock condition signal for generating said lock release signal, and said lock mechanism retracts said locking part (86) to allow movement of said tongue (80) when said lock release signal is received.

7. A lock system as claimed in claim 3, wherein said locking part (86) acts to engage said steering lock tongue (80), when said lock tongue (80) is in an unlock position, to prevent movement of said lock tongue (80), said electronic lock means (32) is responsive to a lock condition signal for generating said lock release signal, and said lock mechanism retracts said locking part (86) to allow movement of said tongue (80) when said lock release signal is received.

8. A lock system as claimed in claim 6 or 7, wherein said lock condition signal indicates locking of the doors of the vehicle and that the speed of the vehicle is at a predetermined level.

9. A lock system as claimed in claim 3 or 6, wherein said lock tongue (80) includes a recess for receiving said locking part (86).

10. A lock system as claimed in claim 7, wherein said lock tongue (80) includes two recesses for receiving said locking part (86).

11. A lock system as claimed in claim 9 or 10, wherein said lock tongue is biased to engage a steering lock mechanism.

12. A lock system as claimed in any one of the preceding claims, wherein said lock mechanism (18,80,88) includes an electro-mechanical blocking mechanism (18,80) with a plunger (20,86) which is biased to extend and is retracted in response to the lock mechanism receiving said lock release signal.

13. A lock system as claimed in claim 1, wherein said switch unit (6) generates signals representative of the position of said movable part (10,110) for said electronic lock means (32).

14. A lock system as claimed in claim 13, wherein said electronic lock means (32) instructs said authentication means (30,39) to interrogate said electronic key (40) for a driver authority signal when said movable part moves between said first and second positions.

15. A lock system as claimed in claim 13, wherein said electronic lock means (32) causes generation of a warning signal when said movable part (10,110) is in one of said positions which does not correspond with a lock signal received by said electronic lock means (32).

16. An electronic system for an ignition and steering lock assembly (4,104), including:

authentication means (30,39) for receiving authentication code transmitted from a remote electronic key (40) and for generating an authentication signal;

electronic lock means (32) of said assembly (4,104), responsive to said autentication signal for generating a lock release signal to release a lock mechanism (18,80,88) of said assembly (4,104); and

an ignition switch unit (6) of said assembly which generates signals representative of the position of movable part (10,110) of said assembly for said electronic lock means (32), said part (10,110) being movable between at least first and second positions (12,14,16,17) to activate said ignition switch unit (6).

17. An electronic system as claimed in claim 16, wherein said electronic lock means (32) receives said code in said authentication signal, and generates said lock release signal on validating said code.

18. An electronic system as claimed in claim 16 or 17, wherein said electronic lock means (32) instructs said authentication means (30,39) to interrogate said electronic key (40) for a driver authority signal when said movable part moves between said first and second positions.

19. An electronic system as claimed in claim 16 or 17, wherein said electronic lock means (32) causes generation of a warning signal when said movable part (10,110) is in one of said positions which does not correspond with a lock signal received by said electronic lock means (32).

20. An electronic system as claimed in claim 16 or 17, wherein said lock mechanism (18,80,88) has a locking part (20,86) which acts to prevent movement of the movable part (10,110) between said first and second positions (12,14,16,17), and said lock mechanism (18,80,88) allows movement of the movable part when said lock release signal is received.

21. An electronic system as claimed in any one of claims 16 to 19, wherein said lock mechanism (18,80,88) has a locking part (86) which acts to engage a steering lock tongue (80) of said ignition lock assembly (104), when said lock tongue (80) is in an unlock position, to prevent movement of said lock tongue (80), said electronic lock means (32) is responsive to a lock condition signal for generating said lock release signal, and said lock mechanism retracts said locking part (86) to allow movement of said tongue (80) when said lock release signal is received.

22. A lock system for a vehicle, including:

a steering lock tongue (80) which is biased to actuate a steering lock mechanism;

a lock mechanism (88) for preventing movement of said lock tongue (80) to actuate said steering lock mechanism; and

electronic lock means (32) for controlling said lock mechanism (88) to enable said lock tongue (80) to engage said steering lock mechanism when predetermined data is received.

23. A lock system as claimed in claim 22, wherein said predetermined data comprises a lock condition signal.

24. A lock system as claimed in claim 23, wherein said lock condition signal indicates locking of the doors of the vehicle and that the speed of the vehicle is at a predetermined level.

25. A lock system as claimed in claim 23 or 24, wherein said lock mechanism (18,80,88) has a locking part (86) which acts to engage a steering lock tongue (80) of said ignition lock assembly (104), when said lock tongue (80) is in an unlock position, to prevent movement of said lock tongue (80), said electronic lock means (32) is responsive to said lock condition signal for generating a lock release signal, and said lock mechanism retracts said locking part (86) to allow movement of said tongue (80) when said lock release signal is received.

26. A lock system as claimed in claim 25, wherein said lock tongue (80) includes a recess for receiving said locking part (86).

27. A lock system as claimed in claim 26, wherein said lock tongue (80) includes two recesses for receiving said locking part (86), and said locking part (86) acts to engage said steering lock tongue (80) of said ignition lock assembly (104), when said lock tongue (80) is in a locked position, to prevent movement of said lock tongue (80).

28. A lock system substantially as hereinbefore described with reference to the accompanying drawings.

29. An electronics system substantially as hereinbefore described with reference to the accompanying drawings.

DATED this 16th day of July 1998

ROBERT BOSCH GmbH

By its Patent Attorneys

DAVIES COLLISON CAVE

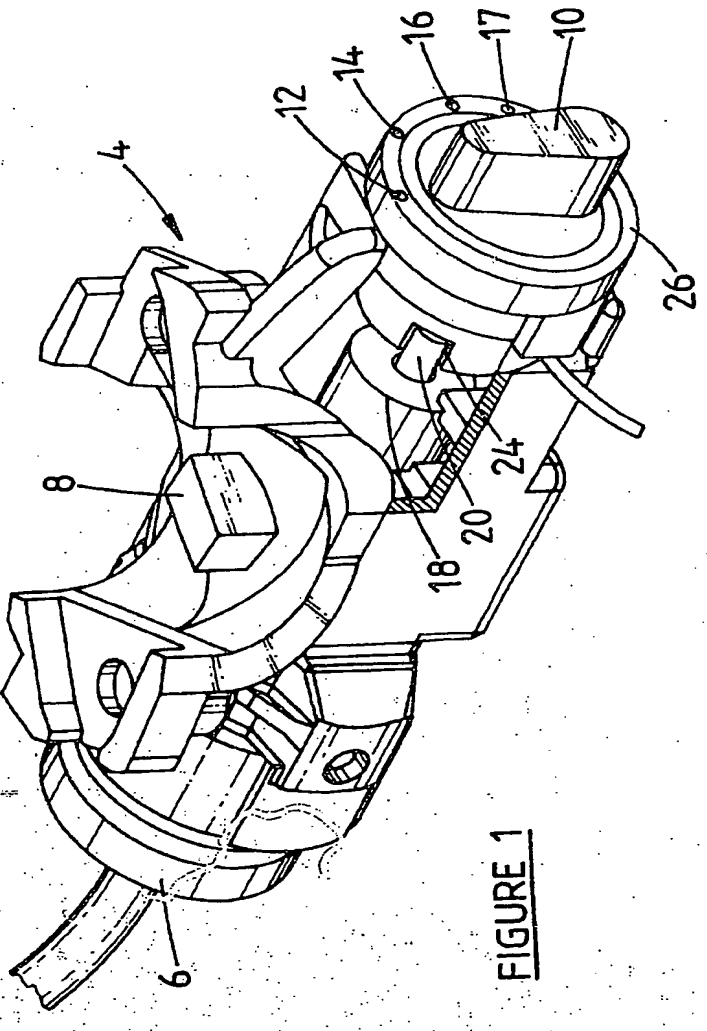


FIGURE 1

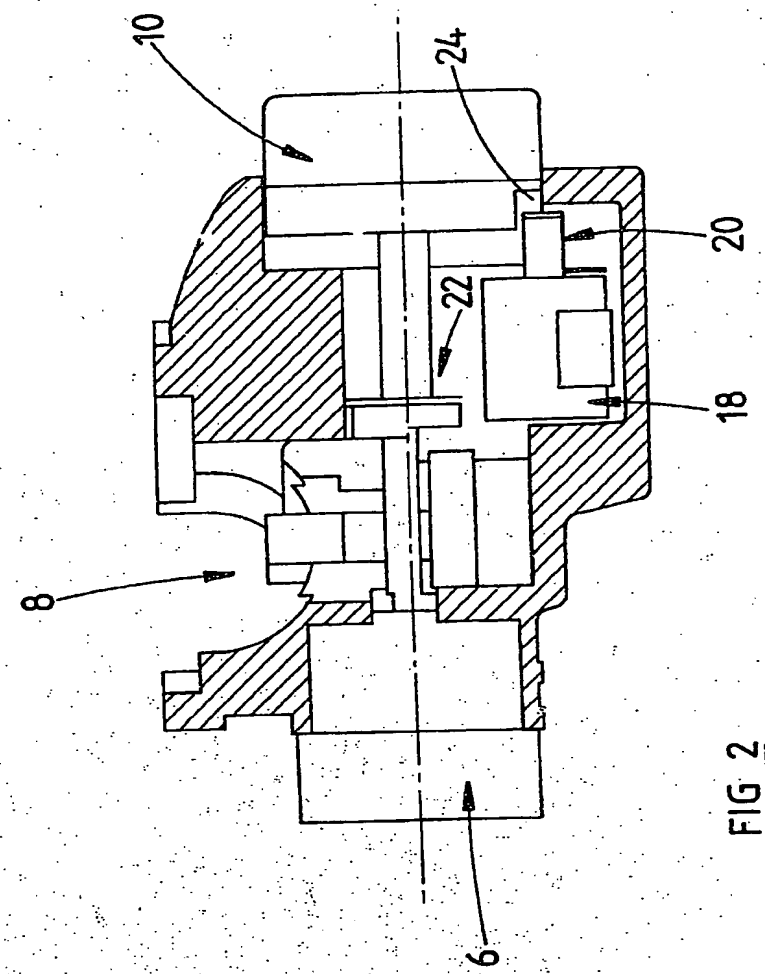


FIG 2

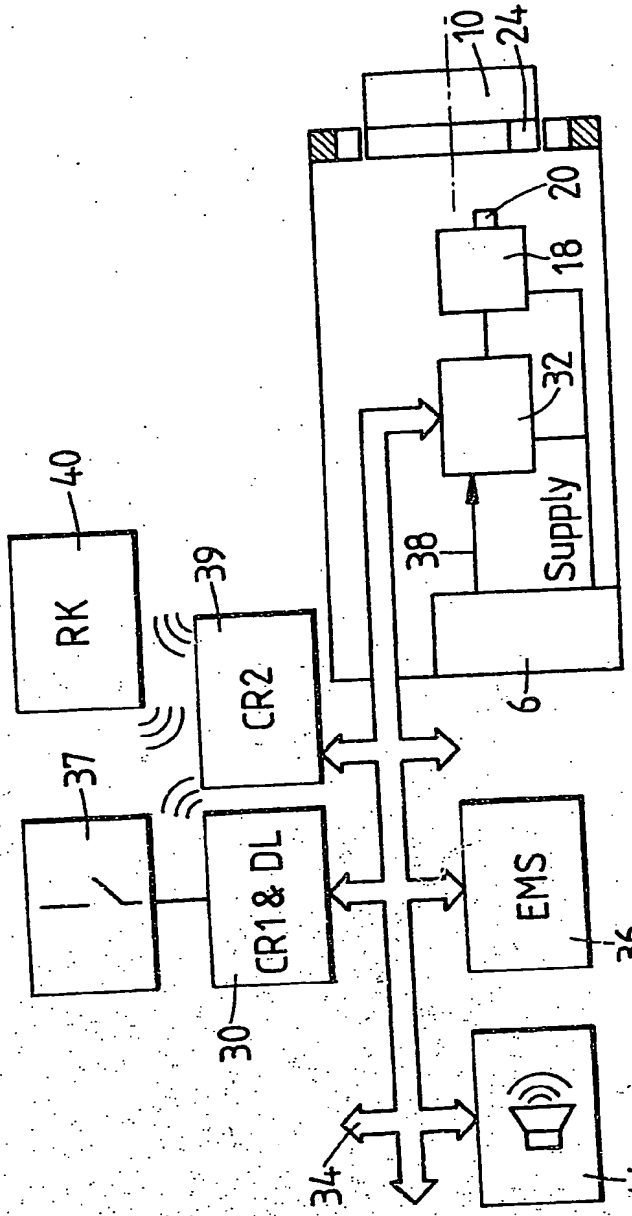


FIGURE 3

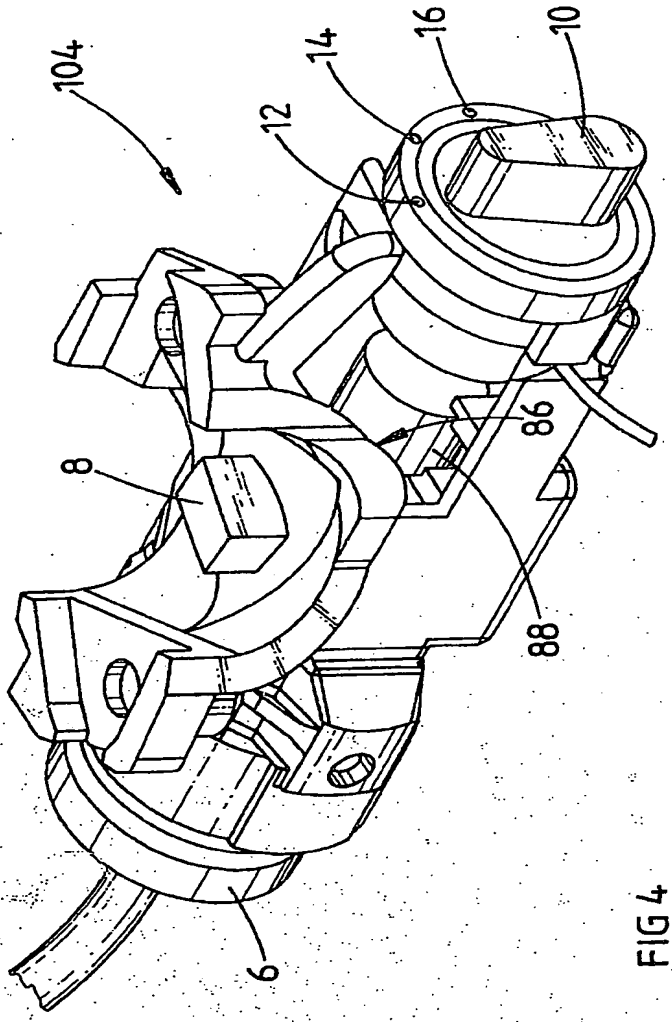


FIG 4

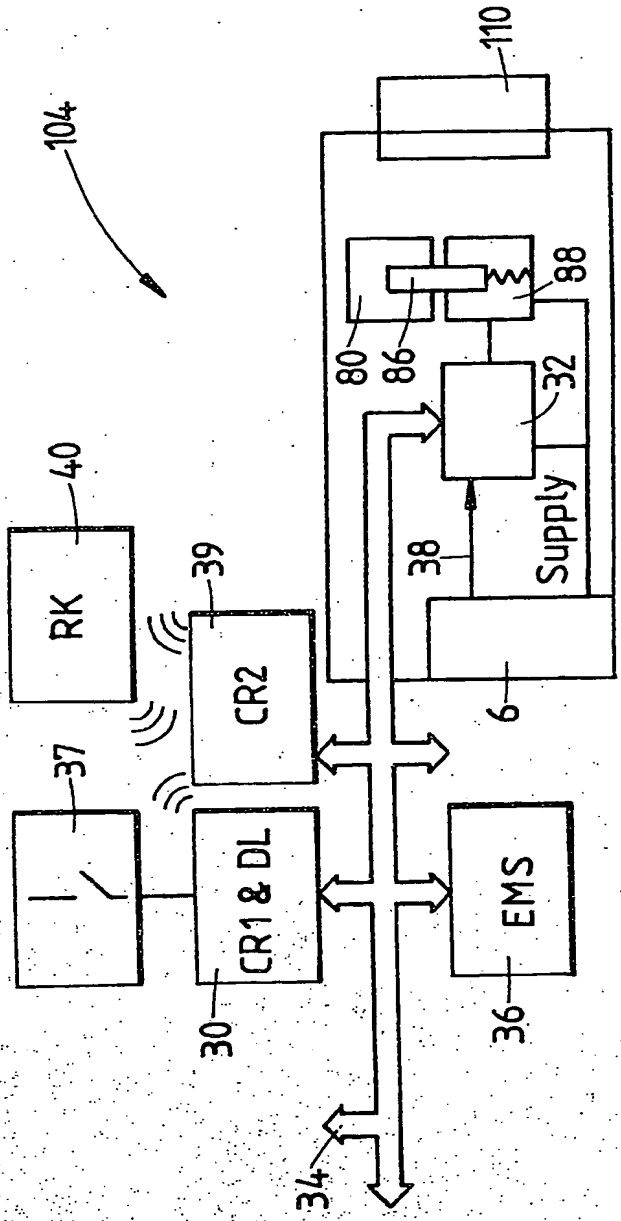


FIGURE 5

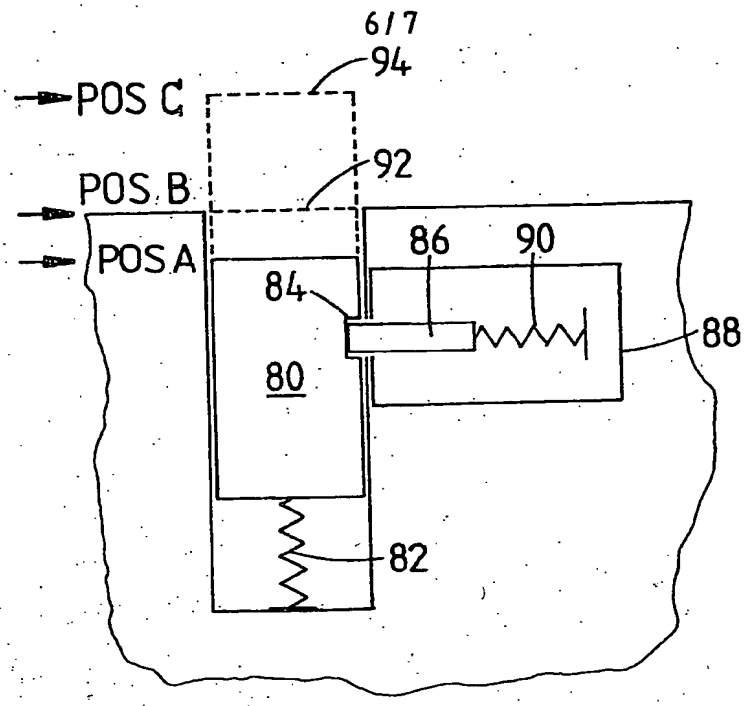


FIGURE 6

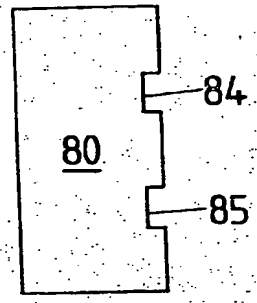


FIGURE 7

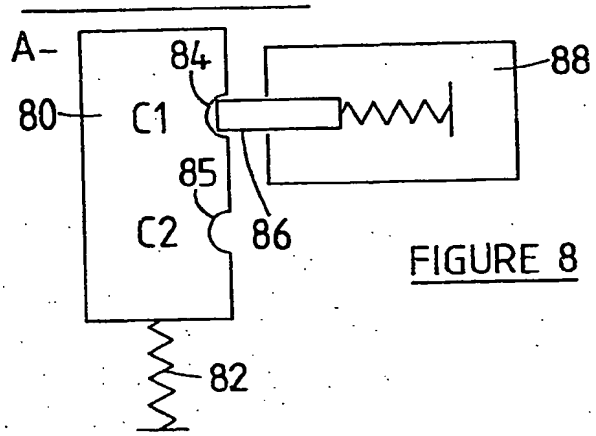


FIGURE 8

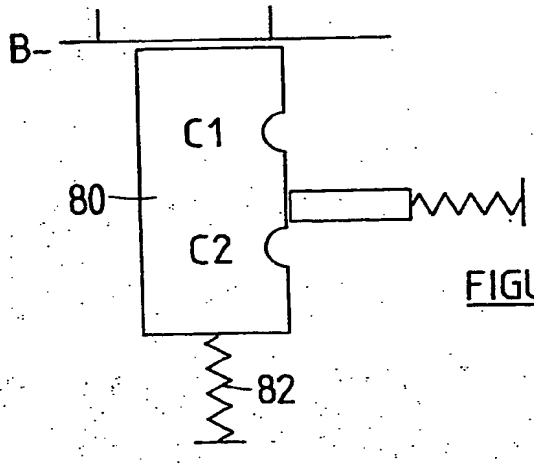


FIGURE 9

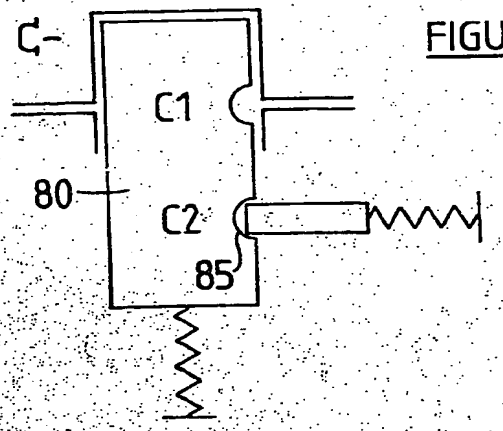


FIGURE 10